6 EXECUTION

In the Execution phase, the initial design concepts are further defined and developed into detailed designs that will be used to procure or manufacture components, fabricate sub-systems, or construct systems, plants, perform remediations, or build facilities. At this point, reporting requirements and baselines for project control are established and subsequently maintained, environmental and safety requirements are satisfied, and the final design configuration is approved and issued for procurement and construction.

This phase is subdivided into two segments: design and construct/fabricate, or plan and remediate. During design, the project is subject to peer or independent reviews and the use of systems engineering techniques, including value management, to ensure the project will provide the essential functions at the lowest life cycle cost consistent with performance, reliability, quality, and safety requirements. Safety, environmental, and quality plans and requirements are to be maintained throughout this phase. The PM should not commit to the performance of any Execution phase task without obtaining required CD approvals and confirming the availability of funds with the appropriate authority.

6.1 Project Execution

Execution comprises the longest and most costly phase of a project, and is the phase when controlling, directing, progressing, and reporting are most important. Project Execution includes project segments that extend from the completion of conceptual design to turnover for operation. Execution thus extends from CD-1, Approve System Requirements and Alternatives, to CD-4, Approve Project Transition Complete, and includes preliminary design, final design, procurement, construction, testing and turnover, and acceptance. Execution is the summation of all previous project activities, and terminates when the project is sufficiently ready to commence turnover, and acceptance of project deliverables by the owner/user.

The process of project Execution requires the PM to coordinate and direct the various physical, contractual, technical, financial, and organizational interfaces that exist during this time. This is particularly important because the Execution phase is the portion of the project that requires the greatest resources, and the time when mistakes can result in the greatest schedule and cost impacts.

The success of the construction and turnover portions of project Execution is dependent upon decisions made during design. Therefore, the PM needs to maintain an awareness of the design philosophy being pursued; design products planned; contracting/purchasing practices, methods and procedures; environmental, safety, health, and quality

requirements; fabrication and construction practices; closeout of construction and procurement contracts; and structures, systems, and equipment checkout, testing, and acceptance. Because of these varied and demanding requirements, the IPT is generally at its greatest number and its greatest diversity during the Execution phase. The Execution phase is also the project phase that requires that a PM (and the IPT) be given significant project authority as well as the support of upper management.

The success of the Execution phase is dependent upon design efforts: pre-acquisition, conceptual, preliminary, and final. No amount of careful project management, construction management, or contracting can guarantee success if the design is flawed, because the products of the design—defining requirements, developing baselines, and developing planning for the remainder of the project—form the basis of all future project activities. For the above reasons, the construction management plan is heavily dependent upon the design stage of the project. This is the reason the IPT needs to include construction, maintenance, and operations-type personnel (members) throughout the design process. The intent of these "precautions" is that approval of significant design or scope changes after preliminary design is complete may be difficult to implement since hardware is impacted and changes require the review and approval of a CCB.

6.2 Preliminary Design

Using the products of the conceptual design, preliminary design initiates the development of a design that is adequate for procurement and construction. This stage of the design is complete when it includes sufficient information to support development of the APB. Generally, this is roughly equivalent to 20 to 35 percent of the total design effort.

6.2.1 CD-2, Approve Acquisition Performance Baseline

At the end of preliminary design, the APB for the project is established and is an accomplishment that leads to a request for CD-2**. All projects shall establish at CD-2 an APB including key performance, schedule, and cost parameters to clearly establish the capabilities being acquired; and the schedule and total cost to acquire the capability.** CD-2 is of paramount importance to the project since it initiates a request for construction funds, which may involve Congress. A request for CD-2 also exposes the project to external reviews and performance of an ICR or Independent Cost Estimate (ICE), if required by the AE. An external review of the project serves as a measure of the Department's overall performance to date. Documentation prerequisites for CD-2 are identified in the PEP. A major input for CD-2 approval includes an ICR and an integrated or separate performance baseline EIR. **An External Independent Review (EIR) shall be performed prior to APB approval at CD-2.** A CD-2 decision is commensurate with the Department's commitment to continue with final design and establish a baseline budget for construction. For software projects, CD-2 marks completion of functional design. This stage describes the logical system flow, data organization, system inputs and outputs, processing rules, and operational characteristics of the software product. If COTS software is selected, it may be purchased upon completion of this stage.

6.2.2 Outputs and Deliverables for CD-2

All current deliverables (all phases in Chapters 4, 5, 6, and 7) need to be outputs and deliverables. During preliminary design the following occurs in support of the request for CD-2:

- Technical, schedule, and cost performance baselines, (the APB) are completed.
- TEC, OPC, and TPC are complete and controlled through the change control process as final baselines are developed.
- The draft PEP is updated, approved, and issued.
- Software logical models and requirements specification are defined.
- The site location is finalized.
- Safety, quality, and environmental documents are refined.
- A PDS for construction is prepared.
- Procurement packages for long-lead procurements may be issued.
- A review of the contractor's project management system may be required.
- An updated RMP is prepared and risk mitigation efforts continue.
- Performance measures for the contractor's performance are finalized.
- Preliminary testing and operating plans are prepared.
- An ICR is performed to further validate the scope/schedule/cost relationship.
- A performance baseline EIR is performed and reconciled.
- A schedule, cost estimate, and work plan for final design is completed.
- A package to request CD-2 approval is prepared.

With this information, the project progresses to CD-2, Approve APB. Even though considerable detailed design remains to be completed, where the maturing design has to support an adequate cost and schedule estimate as discussed in Section 8.2. Approval of CD-2 supports permission and funds to fully complete design efforts. It also establishes the baseline budget for construction.

6.3 Final Design

The remaining design (generally the last half to three-quarters) consists of finalizing the work underway, and producing and releasing construction and procurement documents/ packages. As the design is finalized, the PEP, scope of work, cost estimates, and schedules are updated and approved through the change control process. Mission need is again reviewed, particularly with respect to changing conditions that are not within the control of the project, such as overall site priorities, new technologies, changes in cleanup strategy, changes in planned funding, and so forth. If approved, advanced procurement for long-

lead items may be initiated prior to completing final design to support the project schedule.

6.3.1 CD-3, Authorization to Complete Implementation

With design essentially complete and all environmental and safety documents approved, the project is ready to begin procurement and construction activities. **All projects shall identify a point of full execution and/or implementation (CD-3), schedule an EIR for Major Systems (MS) and an IPR for a Non-MS.** CD-3 approval supports the expenditure of funds for these activities. The decision to proceed with construction is well documented and reviewed by either an EIR for MS projects, or an IPR for non-MS projects. The type of review depends upon the project's TPC. As with other project decisions, there is no substitute for careful, thorough reviews to support an informed decision. Construction is generally performed with capital funds—funding type, however, is not a driver for CD-3.

To this point, each CD has occurred at a discreet time. For particular projects, however, it may be necessary to subdivide CD-3. For example, a long-lead procurement might constrain construction, and an early or phased CD-3 could be initiated and justified. Another example is early start of D&D work for projects which modify existing facilities. In this case, however, the decision is only applicable for that particular procurement package. While there is potential risk in procuring equipment before the design is complete, the potential schedule improvement may be significant and more than compensate for the risk. The need to phase or segment CD-3 is not to be confused with minor, early activities that are necessary, and generally performed prior to CD-3. Activities such as site characterization, limited access, safety and security issues (i.e., fences, etc.) are often necessary prior to CD-3, and may be pursued as long as funding approvals are in place. CD-3 is scheduled to occur late in the design period and is intended as a final check of readiness to proceed. If an early or phased CD-3 is anticipated, the need for this decision and the process should be detailed in the PEP, and if known when the AS is written, in the AS itself.

As described in Chapter 11, "Project Controlling," rigorous project change control is imposed to help control technical creep, which in turn controls schedule and cost creep. The requirement to report the project and budget status continues through construction completion, acceptance testing, final acceptance, pre-operational testing, and turnover of the facility (or equipment) to the user.

6.3.2 Implementation/Construction

With sufficient design complete (generally defined as 60 to 75 percent), and after a final design review, the project is ready for CD-3, Authorization to Complete Implementation. With CD-3 approved, an approval to expend funds for implementation/construction is obtained. Implementation may include activities such as software programming, or remediation of facilities or sites. Appropriate contracts are awarded, and performance is measured in terms of technical, schedule, and cost scopes and baselines. If fixed-price contracts are involved, progress is generally measured via milestones and progress

payments. In all cases, approved and validated project baselines, completed designs, and energetic management control significantly mitigate problems during this stage of DOE projects, especially those unique projects having specialized equipment and processes. Completion of construction and transition into a RA or an ORR are the final steps in the Execution phase, and lead to IOC and CD-4 approval.

6.3.3 Implementation/Construction Activities

During the construction stage of the project, the important elements for success include:

- Clearly identified contract, procurement, and construction contractor requirements
- Effective management and control of technical, schedule, and cost baselines, and risk allocations
- Efficient and effective change control
- Oversight and management of subcontractors and vendors
- Well-planned commissioning and acceptance activities
- Translation of software functional design specifications into a set of technical, computer-oriented system design specifications in preparation for programming installation.

6.3.4 Deliverables for CD-3

- Field Safety Plans
- Detailed design drawing, calculations, and specifications
- Construction Documentation/Task Plan
- Executability Review Report
- Final Design Review
- Interface Control Drawings and Plans
- Completion of the system design stage (for software projects).

6.4 Procurement

Procurement in support of a project can be a lengthy effort, often beginning during preliminary design and extending into construction. Procurement is also a broad effort that includes advertising and awarding contracts for materiels and services, and procuring long-lead equipment items. Key activities that support procurement include contracting, contract management, inspection, statusing, and reporting. Generally, outside expertise is required to support the project in successfully completing this activity.

6.5 Project Management/Integrated Project Team Support Systems

Many processes and systems are available for use during a project's life cycle to aid the project management process. These processes are particularly important during project Execution because the majority of a project's resources are "consumed" during this phase.

A few of the more important processes are identified in the following paragraphs, and the PM should assure these processes are fully functional and operational prior to CD-2.

- Integrated Safety Management System. Assures that safety is included in all project planning documents, especially construction work packages. Required ISM practices are imposed on all project suppliers, contractors, and subcontractors, as appropriate. Safety audits are implemented, and incidents and accidents are promptly and adequately investigated, reported, and communicated.
- Quality management process. Provides assurance that necessary quality features are included in design documents; audits and appraisals to identify system deficiencies are performed, documented and tracked to closeout; inspections are performed as required and deficiencies noted and corrected; and project deliverables meet performance and project mission requirements.
- Resource management process. A structured system that continually evaluates the resources available to the project and compares availability to forecasted project needs. This process continually attempts to identify qualified personnel to assist in project execution.
- Configuration management process. Assures changes to established project baselines are documented, evaluated, and considered at the proper management level for acceptance or rejection. This system also documents all requests for changes, justification for changes, and final decisions concerning changes.
- Cost and schedule estimates are used and updated as required to ensure realistic and accurate performance.
- Change requests. Each project should insist that the individual requesting a change become the "sponsor" of that change and be responsible to complete the change request form identifying technical, schedule, and cost impacts to the project and to any other associated activities. The use of a change-request checklist is encouraged.
- Documentation and data management process. Assures that all essential project documents are prepared, identified, reviewed, approved (as appropriate), reproduced, distributed, filed, and dispositioned at project completion. Also assures that only the latest versions of approved design and construction documents are being used. The documentation process insures the completion of design reviews, prompt response to review comments, and tracking comments to closeout.

  In addition, this process can ensure the receipt of specified contractor, subcontractor vendor data, and its review, approval, and acceptance. This process will prove especially valuable during the turnover and project closeout activities, particularly in obtaining as-builts of all structures, systems, and components.

6.6 Transition/Closeout

Upon completion of construction, the project enters the Transition/Closeout phase. Activities that are included in this phase include checkout, testing, commissioning, facility and documentation turnover (to the user), and training and demobilization. This phase is the period during which the project, or project deliverables demonstrate that they meet IOC, performance requirements, and mission need. (See Chapter 7 and the Practices)

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